

Water: A Critical Material Enabling Space Exploration

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Water is one of the most critical materials in human spaceflight. The availability of water defines the duration of a space mission; the volume of water required for a long-duration space mission becomes too large, heavy, and expensive for launch vehicles to carry. Since the mission duration is limited by the amount of water a space vehicle can carry, the capability to recycle water enables space exploration. In addition, water management in microgravity impacts spaceflight in other respects, such as the recent emergency termination of a spacewalk caused by free water in an astronaut's spacesuit helmet.

A variety of separation technologies are used onboard spacecraft to ensure that water is always available for use, and meets the stringent water quality required for human space exploration. These separation technologies are often adapted for use in a microgravity environment, where water behaves in unique ways. The use of distillation, membrane processes, ion exchange and granular activated carbon will be reviewed. Examples of microgravity effects on operations will also be presented. A roadmap for future technologies, needed to supply water resources for the exploration of Mars, will also be reviewed.